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The road to
High Definition Television

H D T V

Eureka!

EUREKA

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The information in this booklet has been extracted from the Status Report, High Definition Television System, EUREKA Project EU 95 HDTV.

March 1987.

Archimedes is reputed to have leapt from his bath and run naked through the streets of Syracuse shouting, 'EUREKA!' (I've discovered it!).

That was around 250 BC when the great scientist at last found a way of determining the gold content of a crown without damaging it.

2000 years later, in 1985, Europe also cried 'EUREKA' and set up a unique cooperative venture in high technology research and development.

This booklet is about that venture and one project in particular: EU 95 – the road to High Definition Television.

How and why was EUREKA founded?

EUREKA stemmed from an original concept by President Mitterand of France and was officially established at a conference of Ministers of 17 countries and Members of the Commission of the European Communities, meeting in Paris on 17 July 1985:

Austria	W. Germany	Luxembourg	Sweden
Belgium	Greece	The Netherlands	Switzerland
Denmark	Ireland	Norway	United Kingdom
Finland	Italy	Portugal	
France		Spain	

The objectives of EUREKA are to raise the productivity and competitiveness of Europe's industries and national economies on the world market through close cooperation among enterprises and research institutes in the field of advanced technology. EUREKA will enable Europe to master and exploit the technologies that are important for its future and to build up its capacity in crucial areas.

This will be achieved by encouraging and facilitating increased industrial, technological and scientific cooperation on projects directed at developing products, processes and services which are based on advanced technologies and have global market potential.

It has been said that EUREKA is 'Europe's answer to Star Wars' (President Reagan's Strategic Defense Initiative - SDI). It is true that there is a common thread, which we might describe as 'Survival through Technology', and that some European companies are involved in both projects. But the similarities end there.

SDI is a military programme whereas EUREKA projects are civilian and commercial in nature - directed at both the private and public sector markets. Their purpose is to extend or supplement existing European technological cooperation already sponsored by the European communities and to do this with the support of governments of the participating countries.

Links and relationships

EUREKA is not an alternative to existing programmes such as ESPRIT, RACE or BRITE but a series of complementary projects - more than 160 to date. Ministers of the founding countries stressed their support for actions to remove national barriers to progress and create a single European market.

Each participating country will take positive steps to further progress. Typically, these will involve faster granting of subsidies and the removal of bureaucratic barriers to cross-border activities etc. Within EUREKA, a protocol has been established for the discussion and introduction of further measures proposed by participating countries.

Cooperation within EUREKA will enable specialized industries to benefit from the sharing of both exclusive and complementary knowledge and experience. Know-how will be increased; markets expanded.

In short, the EUREKA project brings considerable added-value to cooperative ventures in high technology. This will in turn simplify and speed-up official procedures - especially in the vital area of financial support for feasibility studies.

Who can participate in EUREKA?

In principle, any organisation - of any size - involved in developing or applying advanced technology can play a significant part in an international project. Any company can propose a project in a particular sector but, to qualify as a EUREKA project, certain criteria must be met:

- The project must be likely to contribute to an improvement of Europe's position on the world market
- The participants must come from different European countries
- The cooperation must involve and advance developments in high technology
- The project must offer economies of scale in development and production
- There must be a substantial - financial - contribution from participating companies and organisations

What are typical EUREKA projects?

As mentioned above, EUREKA projects are international, high technology ventures. They vary considerably but the following are typical.

CARMAT 2000

This project was initially proposed by the French car-concern Peugeot and involves Bayer and BASF (W. Germany), DSM (Netherlands), ICI (England) as well as other French concerns. The objective is to produce better and cheaper cars through the introduction of new synthetic and composite materials. This involves developing both the materials and new procedures for their application in the production process.

EAU CLAIR

The Eau Clair project is dedicated to ending industrial pollution of the Rhine and other great rivers. This is caused primarily by the dumping of poisonous and other wastes directly into the water.

The project envisages a closed collection and processing system for such products. This will comprise of a number of collection stations and cleansing units which will not only eliminate pollution but also extract valuable by-products for further use.

There is wide international participation in Eau Clair so its success is not dependent on technology alone. The introduction of a politically acceptable organisational structure for tackling pollution problems is an important aspect of the project.

TRANSPOLIS

Transpolis is a blueprint for freight distribution and storage centres to be located in strategic points across Europe. Here, freighters will find a concentrated range of services: advanced communications facilities, databases on air, sea, rail and road transport, warehousing, transfer and internal transport facilities.

An important aspect is the development of standards for the reporting and processing of information on trade and transport. This will enable transactions to be handled in a uniform, simpler and faster way.

CARMINAT

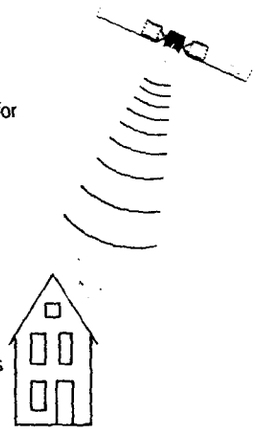
Imagine getting into your car and simply tapping-in your destination on a small keyboard. Your car is fitted with an on-board computer which consults a compact disc store and, using satellite navigation for positional information, computes the distance, direction and appropriate speed to reach your destination – anywhere in Europe.

During the journey the computer constantly checks your speed and position and gives timely advice on which road to take at junctions. The system is linked to an FM radio transmission network which advises detours to avoid traffic jams or roadworks. Because you can concentrate on driving – not navigating – you have a safer journey. You arrive on time, relaxed and refreshed.

It may be a dream today but the EUREKA CARMINAT project is dedicated to making it a reality.

Why a High Definition Television (HDTV) project?

EUREKA EU 95 is the project aimed at defining a world standard for High Definition Television in the 1990s. The full proposal is to be presented to the CCIR plenary assembly of 1990.



It was born of the realisation that there had been no fundamental change in television since the introduction of public black-and-white broadcasting in 1936. Television was based, and continues to be based, on an AM system of Frequency Division Modulation. When colour was introduced, part of the luminance signal was simply 'borrowed' for colour.

The world has moved on since then. Viewers want bigger and better pictures, better sound, more facilities: the cinema experience at home. But we have reached the limits of current technology. Today's television receivers use 625 lines; if we make the screens any bigger, viewers will see the lines.

At the same time, Direct Broadcast Satellites are entering orbit, giving us the opportunity to reach global audiences. But viewers want programmes in their own language so the satellites must transmit many languages simultaneously with each programme. Our present systems do not allow this.

For these, and many other reasons, we must change to a more advanced system. This is the project - EU 95. Its goal is to use new and developing technology to give viewers a greater involvement with programmes than is possible at present. Features of the system will include:

- Hi-fi stereophonic sound
- Multi-channel sound for languages
- A data channel for subtitling, teletext, remote computer access etc
- Scrambling for pay-per-view and access restriction
- Greatly improved picture quality and the elimination of cross-effects
- Wide-screen displays compatible with film
- A doubling of the number of lines to more than 1,000
- The use of much larger screens in the home including future flat screen, wall-mounted displays.

Evolution - not revolution

In setting up the project it was accepted that any system to bring HDTV into the home must integrate developments in the production, transmission, recording and display areas if we are to maximise the benefits.

There are enormous investments in current TV technology - 600 million TV receivers in the home, thousands of broadcast studios etc. It was also realised that the frequency spectrum is not infinite and that there are already heavy demands upon 'airspace'. HDTV will require far greater bandwidth than existing TV systems so it will not be possible to transmit all the new HDTV channels alongside all of today's existing broadcasts.

For these reasons it was decided to adopt an EVOLUTIONARY approach instead of a revolutionary one which would throw the world into turmoil. But evolution is only possible if each step is compatible with the previous and the next. So the idea of COMPATIBILITY was born.

This notion is expressed in three key areas:

AT THE CONSUMER END

Compatibility means that existing equipment is not obsoleted at each step. This follows the tradition set during the transition from black-and-white to colour; old sets could receive the new signals, new sets could receive the old.

It also requires the VCR manufacturer to produce a domestic recorder which will record and replay both 625 line and HD-MAC signals while still giving a reasonable playing time.

The evolutionary approach allows improvements to be made in the future even if they are not feasible today. It allows, for example, the introduction of flat-screen and 3D television without requiring a complete re-engineering of the entire system.

This is possible because the receiver display standards need not be the same as the production studio standard - although they must be complementary.

Compatibility and evolution go hand-in-hand. If a new HDTV service is not compatible with existing systems very few broadcasts will be possible and audiences will be small. This will not encourage programme providers or advertisers. By adopting a compatible approach, the new HDTV service will integrate with MAC-based 625 line systems to reach large audiences from day one.

IN THE PRODUCTION ENVIRONMENT

Compatibility allows world-wide exchange of film and TV productions and easy conversion to transmission standards.

IN THE TRANSMISSION ENVIRONMENT

Compatibility means the transparency of signals with respect to the European MAC standard for DBS which will be in operation at the time of introduction of HDTV.

How the project came into being

The EUREKA 95 HDTV project was a joint initiative of:

Robert Bosch GmbH (W. Germany), N.V. Philips Gloeilampenfabrieken (The Netherlands), Thomson S.A. (France) Thorn/EMI plc (United Kingdom)

Their proposal was submitted to the EUREKA Ministers conference in London on June 30, 1986, via their respective governmental representatives.

The four initiators are known as 'A' participants and they have since been joined by a large number of European industries, public and private institutions and organisations. These are known as the 'B' participants.

'B PARTICIPANTS

Belgium	
Barco Industries	Kortrijk
France	
Angénieux	Saint-Héand
CCETT	Cesson-Sévigné
Société Francaise de Production et de Création Audiovisuelles (SFP)	Paris
Télédiffusion de France	Paris
Germany	
Forschungsinstitut der DBP beim FTZ	Darmstadt
Grundig A.G.	Fürth
Heimann GmbH	Wiesbaden
Heinrich-Hertz-Institut	Berlin
Intermetall	Freiburg im Breisgau
Schneider	Kreuznach
Technische Universität Braunschweig	Braunschweig
Universität Dortmund	Dortmund
Italy	
RAI	Torino
Seleco	Pordenone
Telettra	Vimercate
Sweden	
Swedish Telecom	Farsta
Switzerland	
Kudelski	Chéseaux sur Lausanne
United Kingdom	
British Broadcasting Corporation (BBC)	London
British Telecom	London
Independent Broadcasting Authority (IBA)	Winchester
ITCA	London
Quantel	Newbury
Rank Cintel	Ware
STC Technology Ltd.	Harlow

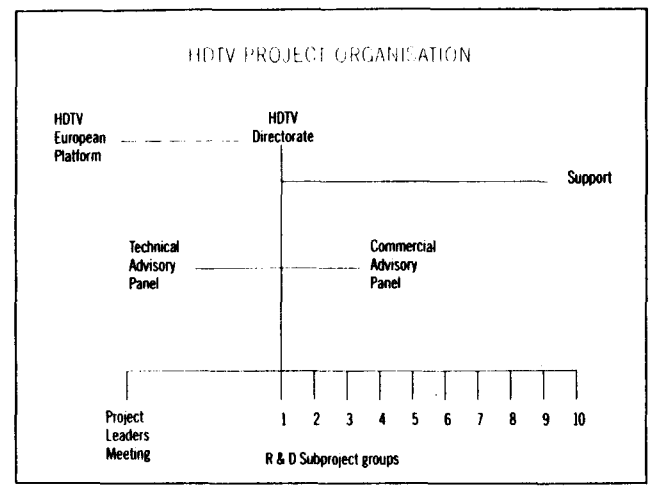
Project organisation

The HDTV Directorate has to manage the project to achieve its goals. It consists of four representatives of the 'A' participants - Bosch, Philips, Thomson and Thorn/EMI.

Presidency - Philips

Vice presidency - Thomson.

The directorate is assisted by a support group, a full-time team from Philips.



The HDTV European Platform

was set up by the EEC to promote the European HDTV system in a coordinated activity of the EEC, broadcasters, national governments and other relevant public and private organisations. The platform also stimulates contacts with similar organisations in the USA and Japan.

The first consortium meeting was held in Darmstadt in October 1986 with government officials from France, Germany, the Netherlands, the UK and the Directorate. It was decided to form a group of four neutral experts to monitor the project and report back to national governments.
These are: France Mr. M. Oudin, Germany Mr. W. Klimek, The Netherlands Mr. J.C. Arnbak, UK Mr. B.J. Rogers.

Directorate Representative Addresses

BOSCH Robert Bosch GmbH, Prof. Dipl. Ing. G. Bolle, Zentralabteilung Entwicklungskoordination und Vorentwicklung Komm. technik, Postfach 50, 7000 Stuttgart 1, W. Germany.

PHILIPS Philips International B.V., Ir. P.W. Bögels, Consumer Electronics Division, P.O. Box 218, 5600 MD Eindhoven, The Netherlands.

THOMSON Thomson Grand Public, Mr. M. Hareng, Scientific and Quality Manager, 74, rue du Surmelin, 75020 Paris, France.

THORN/EMI Thorn EMI Central Research Laboratories, Mr. R.W. Young Manager, EUREKA HDTV Project, Dawley Road, Hayes, Middlesex UB3 1HH, England.

HDTV DIRECTORATE Philips International B.V., Ir. H. Wessels, Corp. Prod. Dev. Coord. VO-1, P.O. Box 218, 5600 MD Eindhoven, The Netherlands.

The Technical Advisory Panel

Consists of 'A' and 'B' representatives and advises the Directorate on technical matters.

The Commercial Advisory Panel

Consists of 'A' and 'B' representatives who study the economic aspects of the HDTV system and report to the Directorate.

R & D Project Groups

Are in charge of sub-projects (see below) and report to the Directorate on the progress of their tasks.

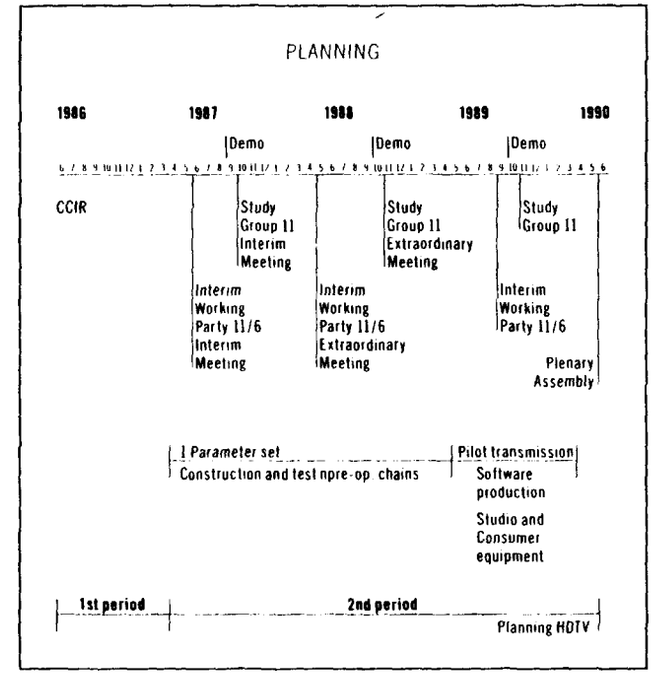
The Project Leaders Meeting

Coordinates the interfaces between the various projects on detailed aspects of technology, costs and planning.

Project planning

The project goal is to develop system standards that allow the introduction of 50 Hz based High Definition Television in the home and to submit a full proposal for a 50 Hz based HDTV system to be ready before the 1990 plenary meeting of the CCIR.

The planning is closely linked to the CCIR schedule below.



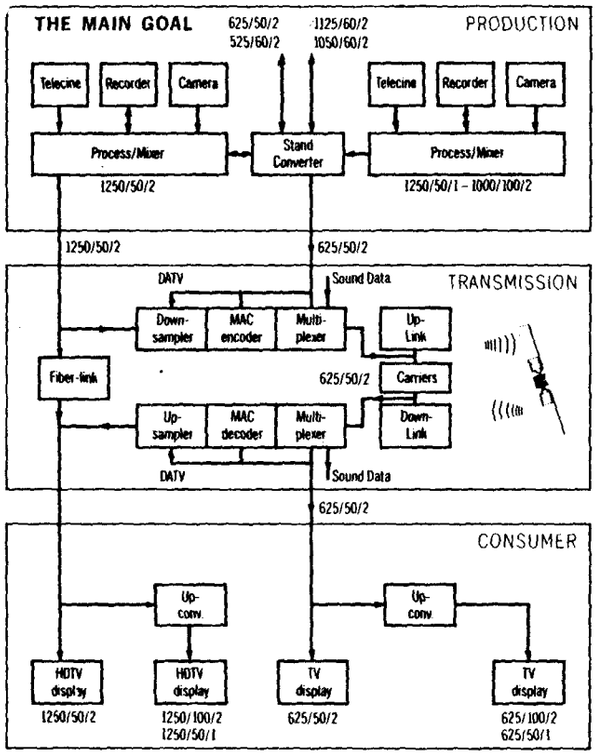
Important milestones are:

September 1987. First public presentation during the Internationale Funkausstellung in Berlin.

September/October 1988. Information to SG 11 extraordinary meeting based on one minimum demonstration chain.

September/October 1989. Information and demonstration to SG 11 based on one demonstration chain and pilot transmission.

May 1990. CCIR plenary assembly.



The individual project groups

Each main task is handled by a Project Group led by one of the participants. The total workload is arranged more by defining disciplines than by defining systems and components. The work of the Project Groups thus typically comprises:

- System studies
- Development of prototypes
- Definition and development of key components.

PROJECT

Number	Title	Project Leader
1	Fundamentals Picture & Sound	CCETT
2	Production – Standards and Conversions	THOMSON
3	Studio Equipment	BOSCH
4	Transmission	IBA
5	HD-MAC Encoding/Decoding	PHILIPS
6	Display Standard and Up-conversions	BBC
7	Receivers	THORN EMI
8	Carriers	PHILIPS
9	Programme Material	RAI
10	Bit Rate Reduction	THOMSON

Project Group 1 – Fundamentals of picture and sound, psychophysics and subjective evaluation

PROJECT LEADER – CCETT

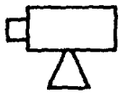
- General studies on picture quality parameters for HDTV. Optimization of signal processing structure and gamma processing. Definition of optimal colour-difference signals. Colorimetry
- Generation of test pictures and sequences
- Subjective evaluation procedures (simulation and real-size equipment)
- General studies on sound quality parameters for HDTV.

Project Group 2 – Production standards and conversions

PROJECT LEADER – Thomson

- Proposal for an optimum world production standard
- Studies on conversions between production standards
- Implementation of the most relevant converters.

PAL
↕
SECAM
↕
MAC



Project Group 3 - Studio equipment

PROJECT LEADER - Bosch

- Definition and development of 50 Hz HDTV studio equipment. Specification of equipment and interfaces. Providing prototypes for demonstrations within the schedule
- Definition and development of key components required for the above studio equipment.

Project Group 4 - Transmission

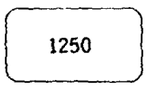
PROJECT LEADER - IBA

- Studies on all hardware aspects of satellite broadcasting of HD-MAC
- Distribution of HD-MAC signals between both studio and up-link and networking
- Work on inter-studio links, and links in general, involving both analog and digital technologies
- Preparation for pilot transmission tests.

Project Group 5 - HD-MAC encoding/decoding

PROJECT LEADER - Philips

- Studies by simulation and hardware of the encoding and decoding scheme for HDTV transmission compatible with the standardized MAC transmission channel
- Hardware realisation of the encoder and decoder part of the chain.



Project Group 6 - Display standard and up-conversions

PROJECT LEADER - BBC

- Studies to define the display standard requirements of HDTV and to identify the optimum standard
- Implementation of the up-conversions, involving the use of direct view CRTs and projection systems and of standardized assessment procedures.

Project Group 7 - Receivers

PROJECT LEADER - Thorn/EMI

- Implementation in demonstration receivers of the results of studies in Project Groups 5 and 6 in HDTV decoding, DATV and up-conversions. This involves the development of suitable components, e.g. 16:9 aspect ratio HDTV CRTs and projection systems, MAC chip set, D/A and A/D ICs etc.

Project Group 8 - Carriers

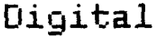
PROJECT LEADER - Philips

- System studies on possible modulation techniques for consumer-oriented carriers:
  a. Video cassette recorders HDTV
  b. Video disc player
  c. Electronic still picture
- Prototype realisation

Project Group 9 - Programme material

PROJECT LEADER - RAI

- Preparation of high quality programme material for effective demonstrations during various phases of the project, taking into account the needs and requests of the other Project Groups.



Project Group 10 - Bit rate reduction

PROJECT LEADER - Thomson

- Study of digital video technology:
  a. for digital HDTV professional and consumer applications
  b. for contribution and distribution links
- Interface with the RACE Main programme.

Selected progress to date

The ten Project Groups are working towards a number of demonstrations to show the progress of their studies between now and 1990. This will involve setting up chains and the submission of papers to the various international regulatory bodies.

The provision of equipment is a major challenge when it is considered that little, if any, 50 Hz based equipment existed only a few months ago. But, already, HDTV cameras, displays and telecines are available to the HDTV participants.

An intermediate working standard of 1250 lines with a 50 Hz field frequency, 2:1 interlace and 16:9 aspect ratio has been selected. Based on this interim standard - because there is no suitable picture memory circuit - a telecine has been constructed to transport film at 50 pictures a second and produce a TV output at 1250 lines/50 Hz/2:1 interlace/16:9 aspect ratio.

Film has been shot at 50 pictures a second both in the studio and on external location. When this is run on the telecine, the combination gives a picture source which is free from most of the instrumental limitations of present day HDTV equipment and is thus a powerful research tool.

The development of system information for coding, decoding and up-conversion is being carried out by computer simulation coupled with the use of stable 625 line equipment. This work is aimed at producing algorithms to provide the basis for the HD-MAC standard.

HDTV computer simulation equipment is also becoming available.